

duced the author to adopt his particular treatment, the effect is to give his work a somewhat disjointed structure. The treatment is slight and "sketchy," and at times inadequate. It is irrational, for example, to dismiss the work of twenty centuries in about as many lines, but this is practically all the space that is given to ancient and alchemistic chemistry. To say that the study of chemistry begins with the work of Boyle is on a par with Wurtz's famous statement that it owes its origin to Lavoisier, and is equally untrue.

Dr. Lowry's book, in spite of occasional slipshod writing, is interesting reading, and the student, if already furnished with a little chemical knowledge, will pick up much information concerning certain broad features in the development of the science since the middle of the eighteenth century. The illustrations of classical apparatus are a valuable feature, although we are unable to see the relevancy of the pictures of crystallised minerals and salts taken from the national collections in the British Museum. They are like the tropes and metaphors which King James deprecated in the sermon—"brilliant wild flowers in the field of corn, very pretty, but of no particular advantage to the corn."

#### RELATIVITY AND ELECTRONS.

*Relativity and the Electron Theory.* By E. Cunningham. Pp. vii+96. (London: Longmans, Green and Co., 1915.) Price 4s. net.

THE principle of relativity has gradually acquired a fundamental position in theoretical physics, and the appearance of an introductory monograph on the subject will be welcomed by all who wish to have a knowledge of its essentials. The present work, as stated in the preface, is written with the purpose of setting out as clearly as possible the relation of the principle to the generally accepted electron theory. Only quite elementary mathematical analysis is employed throughout the book; those who wish to penetrate more deeply in the subject being referred to the author's larger work on "The Principle of Relativity."

In the latter part of the book the principle of relativity is presented from Minkowski's point of view. The four-dimensional form of relativity is of very great importance, partly on account of its elegance and simplicity, but also because of its suggestiveness in the present transition stage of dynamics. Unfortunately, only a short outline of the four-dimensional vector analysis of Minkowski and his disciples is given. On p. 72

examples of 4-vectors are given in a form which is open to criticism. The point-instant  $(x, y, z, t)$  is called a 4-vector. It would be more satisfactory to denote the 4-vector by  $(x, y, z, ict)$ , since  $ict$  and not  $t$  is actually the fourth component of the vector in question. A similar remark applies to  $\kappa(u_x, u_y, u_z, 1)$  (on the same page), which should be written  $\kappa(u_x, u_y, u_z, ic)$ , in which form it would be consistent with the equation at the foot of p. 75, viz.:

$$(S_x, S_y, S_z, S_u) = \rho(U_x, U_y, U_z, ic)/c.$$

The quantity denoted by " $\kappa$ " is, in consequence of a printer's omission, imperfectly defined. The author introduces four-dimensional vectors in the "New Mechanics" in an excellent way by showing how they serve to unify the two aspects of "force" as the "time rate of change of momentum" (Galileo) and "space rate of change of energy" (Huygens). One of the characteristic features of Minkowski's presentation of the principle of relativity is its capacity for unifying or reconciling different and, in some cases, apparently contradictory aspects of phenomena.

In the final chapter the author outlines the way in which the "objections of those who demand a *real* æther to carry *real* effects" can be met.

The work is one of considerable merit, and provides a really good and sound introduction to the subject with which it deals. W. W.

#### THE HANDWORKING OF IRON AND STEEL.

*Forging of Iron and Steel.* By W. A. Richards. Pp. viii+219. (London: Constable and Co., Ltd., 1915.) Price 6s. 6d. net.

THE title of the above work is somewhat misleading, in that its scope is much narrower than is suggested by the title. Apart from a short chapter at the end on steam and power hammers, it deals only with hand-forging in its various aspects. The book, which is stated to be intended both for the "high-school boy" and the "veteran smith"—it is written by an American—opens with a chapter on the historic use of iron and steel from early periods. It then deals in brief review with the smelting of iron ores and the production of cast irons, wrought irons, and steels, the author stating that it is unnecessary to go deeply into the subject of metallurgy or to introduce metallurgical theory. We are told (on page 20) that the air pressure in the blast furnace is from 15 to 25 lb. per square inch. No doubt in the hard-driven American furnaces, where